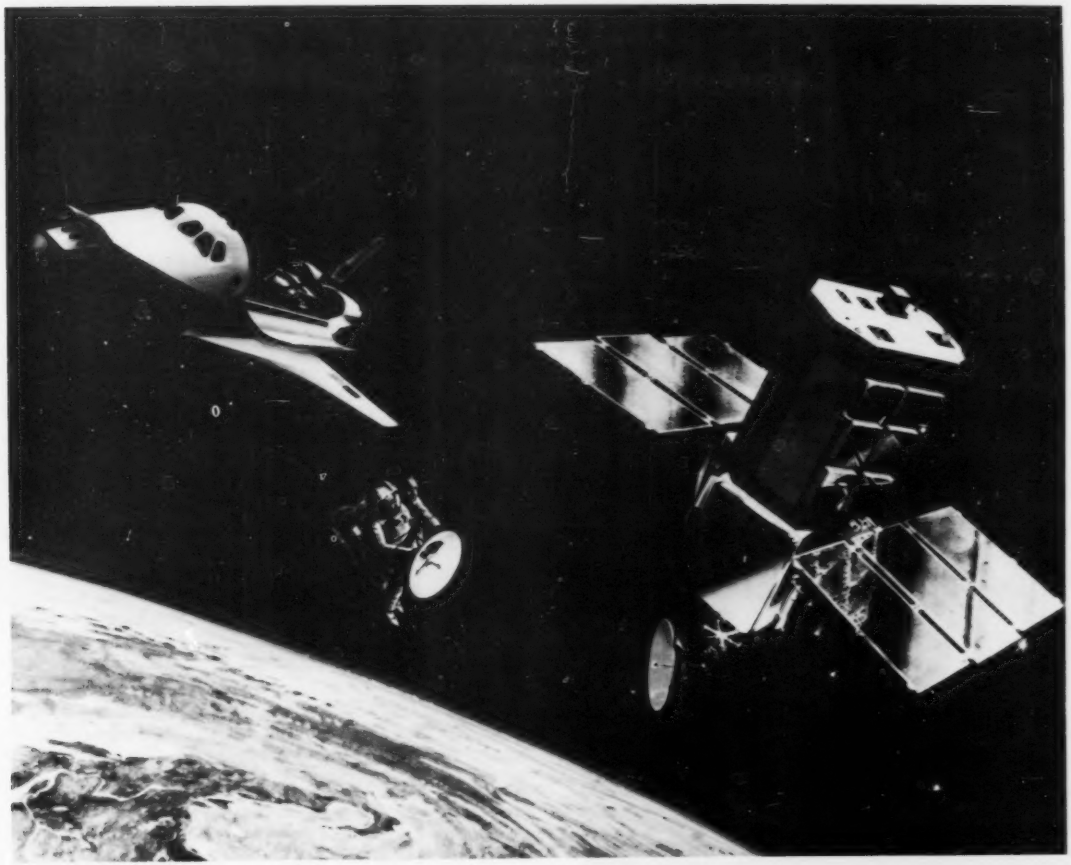
NASA Activities

National
Aeronautics and
Space
Administration

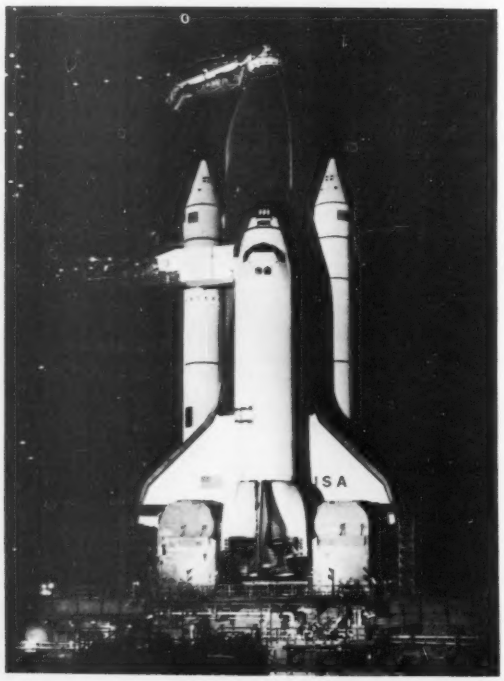
April 1982
Vol. 13, No. 4



About the Cover

Artist concept of NASA's proposed Solar Maximum Repair Mission. On a future Shuttle flight, astronauts would rendezvous on-orbit with the Solar Max satellite, retrieve it, perform repairs within the Shuttle cargo bay and then redeploy the satellite to continue its observation and data collection on the Sun's solar flare activity. If approved, this mission would be manifested for early 1984.

Below, the key to such a mission, the Space Shuttle, awaits its third launch from Kennedy Space Center on March 22. Photo coverage of the Columbia's third successful flight in the orbital test flight series will appear in the May edition of *NASA Activities*.



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NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the Agency's employees.
Contributions and recommendations are solicited from headquarters and field centers, and should be addressed to the Office of Public Affairs, Code LFD-10, Washington, D.C. 20546.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription rate: $16.00 domestic; $20.00 foreign. Price per single copy: $1.75 domestic, $2.20 foreign. Back issues not available.

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Solar Maximum Repair Mission

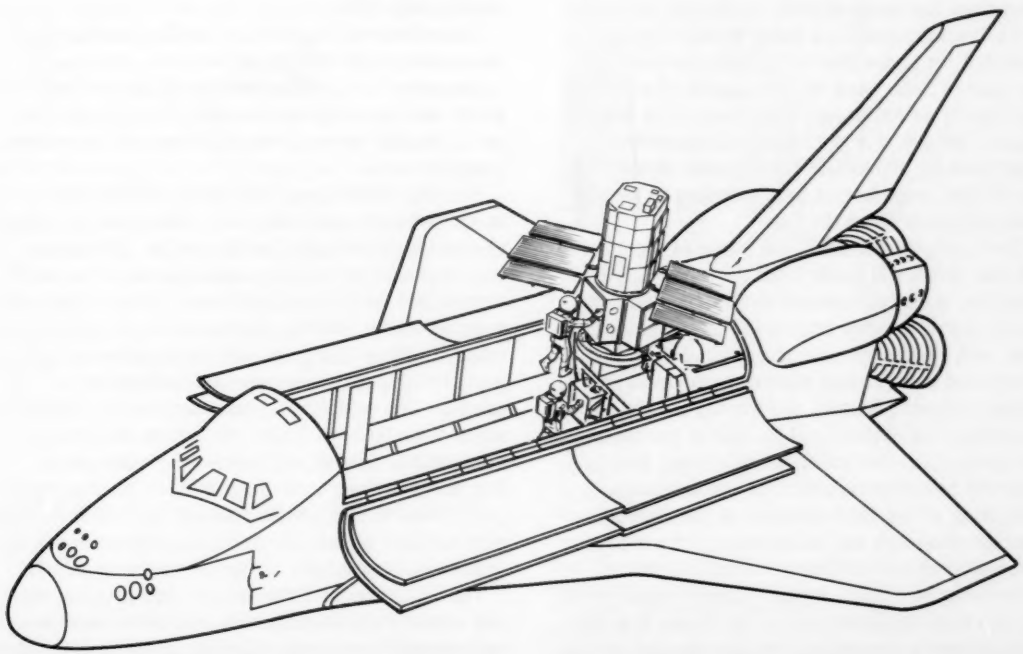
NASA is seeking budget approval to conduct a rendezvous and repair of the Solar Maximum Mission observatory at the end of four years of on-orbit operation using the Space Transportation System and the multimission modular spacecraft flight support system. The mission would be tentatively manifested for early 1984.

The Solar Maximum Mission payload consisted of seven instruments whose prime objective was the coordinated observation of solar flares during the current period of high solar activity. Solar Max, which was launched on a Delta expendable launch vehicle on Feb. 14, 1980, was declared a success after more than seven months of satisfactory scientific observations during which the scientific model of the dynamics of the Sun was greatly enhanced.

Around 10 months after launch, underrated fuses in the attitude control subsystem module shorted out on three of four attitude control momentum storage wheels which caused loss of the precision stabilization. Since that time, the spacecraft has been placed in a slow spin using a magnetic control mode which permits continued operation of three instruments while coarsely pointing at the Sun.

The primary objective of the Solar Maximum Repair Mission is to conduct a technological demonstration of the Space Transportation System's capability for on-orbit rendezvous, servicing, checkout, and deployment of a free-flyer satellite while at the same time restoring the fine-pointing capability of the Solar Max observatory and thus the capability for operation of the science instruments. The pointing repair will be achieved by on-orbit replacement of the attitude control subsystem module with a Landsat-D/Solar Max flight spare. This capability is provided by the modular design of the multimission modular spacecraft which is the first application of this technique for free-flyer/Space Transportation System interface compatibility. Replacement of the attitude control subsystem module by extravehicular activity will restore full scientific operation to six out of seven instruments in the Solar Max payload.

A secondary objective is to eliminate operating instrument anomalies by extravehicular activity installation of a plasma baffle (deflection cover) over the soft X-ray polychromator propane exhaust port,



Artist sketch of the Solar Max satellite retrieved from its orbit and placed onboard the Space Shuttle for repairs.

replacement of the hard X-ray imaging spectrometer, front aperture thermal blanket and, if time permits, replacement of the failed coronograph/polarimeter main electronics box. This would return the entire Solar Max observatory to full operation.

Before the attitude control system on Solar Max malfunctioned, many unique observations of solar flares had been made and a number of these observations have provided new insights into the physics of flares.

Investigators from each of the Solar Max instrument teams currently are working in collaboration with NASA's Goddard Space Flight Center which operates the Solar Max observatory to understand the full significance of the data thus far collected. Approximately 30 papers have been published or have been submitted for publication on the Solar Max results. Three of the seven instruments continue to collect significant data: the solar constant, gamma-ray, and hard X-ray burst experiments.

As impressive as the Solar Max results have been thus far, one must realize that the investigators were still not yet using the full observing power of the mission when the attitude control subsystem malfunctioned. This untapped potential could be fully realized with the renewed mission that would result from the repair activity. Following activation of the Tracking and Data Relay Satellite System, scheduled for Space Shuttle launches six and eight, the repaired Solar Max will be capable of supplying high-quality real-time solar observations on Sunside passes. This will give investigators unprecedented capabilities for immediate participation in the conduct of their experiments by responding to rapidly developing activity on the Sun.

The hiatus, between the first phase of the mission and that which will result from the repair activity, offers two major advantages to the scientific community. First, detailed understanding of the early Solar Max results will spur the generation of highly refined and well focused observing programs for the renewed mission. Second, considering the time in the solar cycle, the payload will be able to pursue several interesting quiet-Sun scientific objectives. Among these will be the investigation of coronal holes, monitoring of the solar constant as the cycle approaches minimum and monitoring of the evolution of the solar corona during the minimum period.

The Solar Maximum Repair Mission would be the first practical demonstration of the Space Transportation System's capability to rendezvous and service a free-flyer satellite. A number of missions, such as Landsat-D, Long Duration Exposure Facility, Upper Atmosphere Research Satellite, Gamma-Ray Observatory and Space Telescope, have considered retrieval and/or servicing for the purpose of refurbishment and reuse.

An assessment of long-term space environmental effects on the recovered hardware will be performed and the Solar Max attitude control subsystem module will be reworked to support the requirements of the Landsat-D program.

The magnitude of rework and associated cost of refurbishment will help establish guidelines in planning future reuse of free-flyer spacecraft parts and the flight support system by other missions. The lessons learned in the course of the mission and in postlanding analyses will help generate improved techniques for the design of future Shuttle-compatible spacecraft.

The baseline Solar Maximum Repair Mission is planned as a five-day operation with the Space Shuttle employing direct injection to the operational attitude. The rendezvous with the Solar Max observatory will be at an altitude of 490 ± 20 kilometers (265 ± 11 nautical miles) and inclination of 28.5 degrees. The mission, which may be conducted as a shared mission if another suitable payload is available for manifesting in this timeframe, would be launched from NASA's Kennedy Space Center, Fla., during early 1984.

The orbiter will carry a crew of four and a repair cargo consisting of the flight support system, a replacement multimission modular spacecraft attitude control subsystem module, experiment repair parts, module service tools, and manned maneuvering unit.

Phasing of the Space Transportation System launch window and subsequent orbital maneuvering system burns are such that the orbiter will rendezvous and station keep at a safe distance of about 90 meters (300 feet) from Solar Max. An astronaut will approach Solar Max by untethered flight using a manned maneuvering unit equipped with a special trunnion grapple to capture and stabilize the satellite. The orbiter will then maneuver to within about 9 m (30 ft) of Solar Max where the Remote Manipulator System will capture the observatory. The arm will then berth Solar Max to the flight support system in the Shuttle payload bay, the multimission modular spacecraft umbilical connectors will be remotely engaged, and the spacecraft powered off.

The astronaut with the manned maneuvering unit will move to the location over one of the solar arrays to install a plasma deflection cover over the soft X-ray polychromator propane exhaust port. Following this, the astronaut will fly to the top of the observatory and install a replacement thermal

blanket over the hard X-ray imaging spectrometer instrument collimator. The astronaut will then stow the manned maneuvering unit and join a companion to exchange the attitude control subsystem module. They will be aided by such items as manipulator foot restraints, portable foot restraints and module service tools.

The final repair operation will consist of removing and replacing the main electronics box of the coronograph/polarimeter and the panel on which it is mounted. The same major extravehicular activity service aids will be used. This will conclude extravehicular activities.

The crew will reactivate the spacecraft from the aft flight deck. A functional checkout of the Solar Maximum Mission will be performed remotely from the Goddard Space Flight Center Solar Maximum Mission Project Operations Control Center. If sufficient orbital maneuvering system propellant remains, the orbiter will reboost the Solar Max to its initial 575 kilometers (310 nautical miles) operational altitude to provide for extended operations. The Remote Manipulator System will then be used to redeploy the Solar Max observatory. Consideration is being given to deployment of the Solar Max's tracking and data relay satellite system high-gain antenna system either just prior to or following the observatory redeployment. The orbiter will then back away from Solar Max, prepare for deorbit, and land at Kennedy Space Center, Fla.

After landing, the flight support system, coronograph/polarimeter main electronics box, and retrieved attitude control subsystem module will be removed from the orbiter and transported to a hangar for inspection. The attitude control subsystem module will then be returned to the module contractor for testing and refurbishment as a Landsat-D spare. This will allow the first hands-on detailed engineering assessment of the effects of extended spaceflight on satellite hardware. The flight support system will be placed in storage until required for the next mission.

ESA Solar Cell Arrays Tested at Marshall

A 14-month-long test of the electrical performance of the solar cells that make up the solar arrays (antennas) for the Space Telescope began in January at NASA's Marshall Space Flight Center, Huntsville, Ala. ESA is furnishing NASA with the Solar Array Assembly for the Space Telescope. Seventy-two cells will be exposed to the equivalent of five years of thermal cycling of +100 to −100 degrees Celsius in the Center's test laboratory thermal vacuum chamber. The cycling represents the extreme range of temperatures the arrays will experience as they move between the Earth's shadow and sunlight.

During the tests, the solar cells, measuring only 20×40 millimeters each, will be subjected to 30,000

March 5, 1982

Dear Cols. Lousma and Fullerton,

Please don't swat Todd's bugs! It would hurt Todd's feelings. They are part of his experiment. We are curious to know how the bugs fly with no gravity. If they get out of the boxes, you could use a net to catch them.

We can hardly wait for the blast off! We hope you have a good ride in the space shuttle. We'll be watching you on TV and we'll wave at you. We are proud of you and Todd.

Love,
The Southland
Kindergarten
Rose Creek, Mn.

Bugs Have Feeling Too—The third flight of the Space Shuttle carried an experiment designed by Minnesota high school student Todd Nelson to test the effects of weightlessness on three types of insects. This letter, sent from an elementary school in Todd's school district, was in response to a joke made by the Shuttle prime crew about Todd's experiment during a pre-mission press conference.

cycles of heating and cooling. The cycles are equivalent to the number of cycles to be experienced by an array in its design life of five years.

The test of the cells is also designed to study the weld integrity of the cells in the flight configuration. There are 48,760 cells in both arrays, one on each side of the Space Telescope, that will be extended to provide electrical power for the Telescope after it is deployed in space by the Space Shuttle.

Jean Claude LaRue of ESA brought the samples to Marshall in January for the test startup and will make periodic return visits during the duration of the program.

Space Telescope, a project managed by Marshall, is scheduled for launch in the mid 1980s.

Lighter Shuttle Fuel Tank in Production

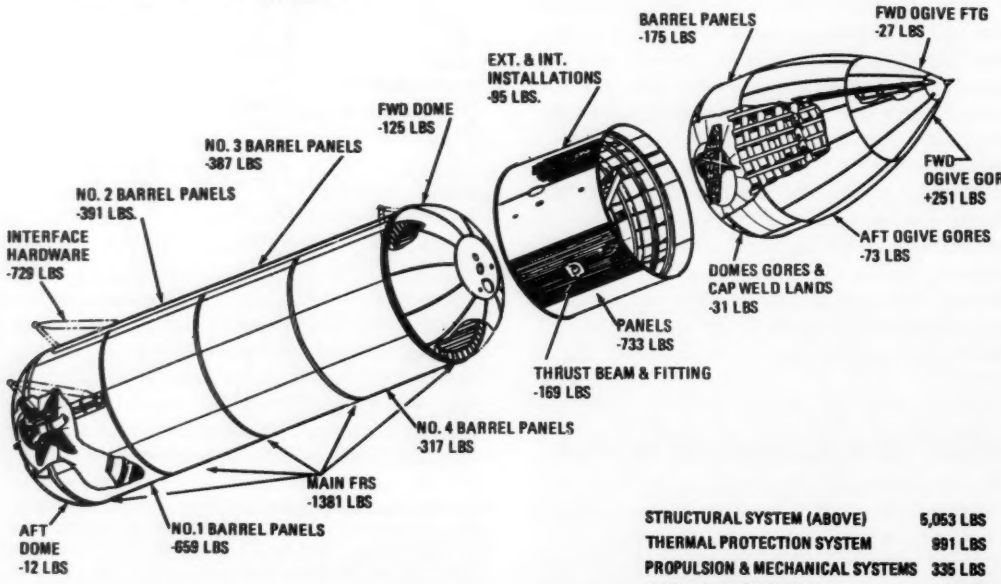
A modified version of the Space Shuttle's external propellant tank—6,000 pounds lighter than the one which was part of the maiden flight of the Columbia—is in production at Martin Marietta Aerospace, Michoud Division, New Orleans, La. Because of its lighter weight, the modified tank will increase the Shuttle's payload-carrying capability by about the same amount.

Since the external tank is the only major non-reusable element of the Shuttle, one tank must be made for each launch. The external tank which was part of the maiden flight of the Space Shuttle Columbia weighed about 77,000 pounds. more than 1,000 pounds less than the NASA-specified weight limit. The second weighed even 200 pounds less. Each of the new lighter weight external tanks will weigh about 71,000 pounds, for a trim three-ton reduction.

The Michoud Division of Martin Marietta Aerospace designs and assembles the giant tanks for NASA in New Orleans and has been working on the lighter weight tank project for two years.

"In 1979, we began working with NASA to trim 6,000 pounds from the tank's weight," said William Barrett, manager of Martin Marietta's work on the lightweight tank. "Actually, with most of the engineering work done and fabrication started on the first four lightweight tanks, we are currently predicting a 6,400-pound reduction, leaving a 400-pound margin for contingencies."

SPACE SHUTTLE EXTERNAL TANK
WEIGHT REDUCTION SUMMARY



STRUCTURAL SYSTEM (ABOVE)	5,053 LBS
THERMAL PROTECTION SYSTEM	991 LBS
PROPULSION & MECHANICAL SYSTEMS	335 LBS
RANGE SAFETY SYSTEM	27 LBS
TOTAL WEIGHT REDUCTION	6,406 LBS

The first four of the so-called lightweight tanks are in various stages of production. The first lightweight tank will be delivered in September 1982 and will be used for the sixth Space Shuttle mission.

"We have used several methods to trim the 6,000 pounds," Barrett said. "One was to make design changes as a result of the information obtained from our very successful structural tests." These changes include the elimination of selected stringers, using fewer ring stiffeners and modifying major frames in the liquid hydrogen tank.

Some fabrication techniques have been changed. For example, dome caps on the first tanks were chemically milled on only one side. Now the caps will be milled on both sides to reduce thickness and weight—without sacrificing the required strength.

"We also changed some materials to take advantage of recent developments in the metals field," Barrett added. "For example, we've reduced the weight of the aft solid rocket booster attachments on the lightweight tanks by making them out of a stronger and a less expensive titanium alloy."

Operational considerations and test data also allowed engineers to eliminate an anti-geyser line used in the liquid oxygen fill system and to relocate the hydrogen pressurization line. The result was a weight reduction of several hundred pounds and a cost reduction.

Although most of the tank's alterations will not be apparent to casual observers, one change is already obvious: six hundred pounds of white latex paint was missing from the tank's surface for the third flight of the Columbia in March. After analyzing data from the first Shuttle mission, NASA and Martin Marietta engineers determined that the external tank's thermal protection system would adequately protect the tank without the paint.

Martin Marietta engineers are evaluating additional weight saving measures which may be implemented in the future. After analyzing information received during the Shuttle's test flights, they may be able to eliminate 1,000 pounds by removing a large slosh baffle from the liquid oxygen tank. Cable trays which now run nearly the length of the tank may be eliminated if electrical cabling is routed through the tank's interior. Lighter weight composite materials could also be substituted for some heavier metal parts. These changes may be made if they can result in cost as well as weight savings.

Martin Marietta builds the external tanks under contract to NASA's Marshall Space Flight Center, Huntsville, Ala.

Astronaut Kerwin Appointed as NASA Representative in Australia

Astronaut Dr. Joseph P. Kerwin has been appointed by NASA to assume duties as the agency's Senior Scientific Representative in Australia effective this month. Upon conclusion of this two-year assignment, Kerwin will return to the Astronaut Office at the Johnson Space Center, Houston.

Kerwin will report to Robert E. Smylie, NASA Associate Administrator for Space Tracking and Data Systems, and will act as liaison between that office and Australia's Department of Science and Technology. He succeeds H. William Wood who has been appointed to the post of director of the Network Systems Division in Smylie's office.

NASA has had a representative in Australia for almost 20 years. Two NASA tracking stations—at Yarragadee and Orroral Valley—support Space Shuttle operations by providing voice contact and data acquisition and relay. Another tracking station near Canberra is used to track deep space probes.

Kerwin's responsibility will be to coordinate NASA tracking requirements with the Australian government and assure its awareness of NASA's plans in space, as well as to facilitate a productive climate for scientific cooperation.

Slayton Leaves NASA

Donald K. "Deke" Slayton, 58, manager for orbital flight test in the Space Shuttle Program Office at the NASA Johnson Space Center, Houston, left NASA in March after 23 years with the space agency. Slayton is the last of the original seven astronauts still with NASA who were selected in 1958 for Project Mercury. Slayton retired from NASA in February 1981, but stayed on the job on a temporary appointment as a rehired annuitant.

He will serve as a consultant to Aerospace Corp. of El Segundo, Calif., and to Space Sciences, Inc., of Houston, from a Clear Lake-area office.

Slayton said of his two decades with the space program: "There's nothing I'd rather have been doing. I really looked forward to getting up each morning. But this new phase of my career looks like it also should lead to constructive, enjoyable work."

Grounded from space flight in August 1959 because of a suspected heart condition, Slayton later was approved for flight and was part of the American crew in the July 1975 U.S.-U.S.S.R. Apollo Soyuz joint space rendezvous and docking mission.

While grounded, Slayton served as head of the Astronaut Office and Director of Flight Crew Operations at the Space Center. Slayton resigned from the Air Force in 1963 and joined NASA. He was manager for the approach and landing tests with the Space Shuttle orbiter Enterprise from 1975 to 1977. In 1977 he was named to manage the four-mission orbital flight test program with orbiter Columbia to bring the Shuttle Space Transportation System to operational readiness.

Slayton joined the Air Force in 1942 as an aviation cadet and flew 56 combat missions in Europe and seven over Japan as a B-25 bomber pilot. He was a test pilot at the Air Force Test Pilot School at Edwards Air Force Base, Calif., when he was selected as a Mercury astronaut. Slayton has logged more than 7,000 hours flying time, most of which is in jet aircraft.

Pigeon Courier Service Aids NASA Aerospace Contractor

Homing pigeons have found a roost in the computerized aerospace world of one of NASA's major contractors, Lockheed Missiles & Space Company. The feathered couriers are carrying microfilm data from the company's main plant in Sunnyvale, Calif., to its test base in the Santa Cruz mountains.

Lockheed's newest employees are traversing the 25-mile span in about half the time it takes an automobile to cover the distance over trafficked highways and twisting mountain roads.

According to Lockheed, interplant pigeon service was born of both need and inspiration which arose in the following way. Designers and engineers at the Santa Cruz test base use a computer graphics design and drafting technique called CADAM®. To use CADAM, they operate a Santa Cruz terminal (a keyboard and video display screen) that is connected by microwave to computers at Lockheed's Sunnyvale facility. The results of each day's design work are stored in the Sunnyvale computers.

But to achieve design continuity, the Santa Cruz people each morning needed an immediate printout of all work completed by the end of the previous day.

That printout could not be produced at Santa Cruz without installing expensive equipment. And getting that information on microfilm from Sunnyvale by express courier service also was quite costly.

Inspiration came to the rescue. Robert Nelson, a design specialist at Lockheed's Santa Cruz base, recalled seeing a television show in which homing pigeons were used to fly blood samples from various hospitals to a central laboratory at a great savings in cost and in time.

He interested Werner Deeg, a research scientist who heads the chemistry laboratory at Santa Cruz, a man with a penchant for things of nature. Says Nelson: "When I first mentioned a possible pigeon service to our base manager, his reaction was expected: he laughed. But he agreed we should try it." Lockheed did, with Deeg becoming the entrepreneur who is developing the pigeon flock.

In operation, the pigeon service works this way. Santa Cruz design drawings each day are extracted from Lockheed's computers at Sunnyvale and converted to microfilm. A strip of film is rolled into a small plastic tube attached to the pigeon's leg.

The pigeon (a pair is delivered to Sunnyvale daily by routine in-plant truck service) is then released and flies to its home loft at the Santa Cruz test base in about 40 minutes. There the film is printed as an enlarged drawing and given to the designer who can continue with the next computer-aided design step.

The success of this pigeon service would have been predicted by pigeon fanciers and those aware of the historical exploits of homing pigeons. The records of these reliable birds, whose homing instinct still is not fully understood by investigators, includes both peacetime and wartime achievements.

The carrying of blood samples is a recent one. Others are more historical, such as the pigeon service used by Julius Reuter (founder of the news agency which bears his name) in 1850 to carry up-to-date

financial news from the Brussels stock exchange to Aix-La-Chapelle (Aachen) Germany.

Or the flight of the famous "Cher Ami" during World War I, a heroic bird who flew through enemy fire and though badly wounded, successfully delivered a message which enabled the rescue of a trapped American battalion of the 77th Division.

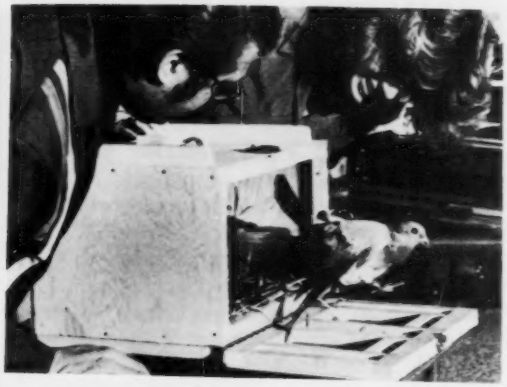
Or even the record flight of one bird, from France to Saigon—a distance of 7,200 miles which the pigeon traversed in 24 days.

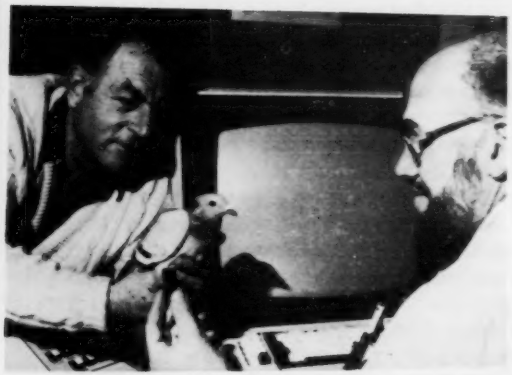
Experience has shown that over distances of a few hundred miles, pigeons are almost 100 percent reliable. From Lockheed's facility at Sunnyvale to its Santa Cruz test base, the distance is moderate—to pigeons just an exercise flight. But it is another confirmation of the service done by these birds who through their entrance into this arena of technology, are adding another line to their fascinating history.

Inspector General Activities

Upon receiving a claim for payment from a NASA contractor, an alert NASA employee questioned the validity of the claim. Subsequent review of the claim by NASA and the Office of the Inspector General resulted in the conclusion that not only was the claim marked up, but that it should be disallowed as nonfactual, based on the lack of supporting documentation. Further evaluation of the firm's records subpoenaed by a Federal grand jury was performed by the Office of the Inspector General. Although criminal intent could not be established, the claim has been withdrawn by the contractor and, in so doing, has resulted in a cost avoidance to NASA of approximately $400,000.

On January 27, 1982, a Federal grand jury issued an indictment charging three NASA contractors and





Lockheed microfilm carried by a pigeon courier is contained in a capsule attached to the pigeon's leg (left photo) with a padded Velcro band, quickly detachable when the bird arrives at its home loft in the Santa Cruz mountains. In top photo, a pigeon takes off from Sunnyvale with its "mail" for Santa Cruz as Lockheed personnel Tom Birley and Linda Marvin observe. Pigeon domestication dates to 3,000 B.C. The merging of that ancient means of communication with modern technology is symbolized in bottom photo where Werner Deeg, Lockheed research scientist, holds a bird in front of the computer-design terminal and Robert Nelson, Lockheed design specialist displays the film that the pigeons deliver daily to Santa Cruz.

three of their employees with fraud. The indictment alleges that over a period of several years the defendants conspired to file false statements in connection with construction contracts of support facilities for the Space Shuttle. One defendant has pleaded guilty to filing false statements and has been sentenced to pay $10,000. The indictment culminates a three-year investigation by NASA's Office of the Inspector General and the FBI.

NASA's Office of the Inspector General urges you to continue your efforts in meeting the challenge of improving NASA programs. Suggestions for eliminating waste and mismanagement are welcome. Identities can be confidential. A 24-hour answering service is available in the Washington, D.C. area on 755-3402, or call (800) 424-9183 (toll-free for all other areas). Please send written suggestions to: NASA Inspector General, P.O. Box 23089, L'Enfant Plaza Station, Washington, D.C. 20024.

Contractor News

Wiltech Florida Corp., Titusville, Fla., has been awarded a cost-plus-award-fee contract by NASA's Kennedy Space Center, Fla., for component refurbishment and chemical analysis services at the Center. The amount of the contract award is $3,054,939 and covers the period from Mar. 1, 1982 through Feb. 28, 1983. Wiltech is a small business firm. Among the components that Wiltech will be responsible for are the valves and pumps that are located on the gaseous and liquid propellant lines that feed fuel used by NASA's Space Shuttle. Wiltech will also take over KSC's chemical analysis service. Much of the chemical observation will be undertaken by the technique of gas chromotography, in which various liquids and gases are separated to determine if any impurities are present. Shuttle fuels such as hydrazine, used in the shuttle orbiter's onboard propulsion systems, go through this process.

Martin Marietta Aerospace, Denver, has been selected by NASA's Jet Propulsion Laboratory, Pasadena, Calif., for negotiations to study options for a spacecraft for a potential Venus radar mapping mission. Cost for the study contract and duration of the work effort are yet to be determined.

S & Q Corp., South San Francisco, Calif., has been awarded a contract valued at approximately $1 million, by NASA's Langley Research Center, Hampton, Va., for the design and fabrication of components for a water jet propulsion system. The components, a large diameter, high-pressure propulsion control valve, jet nozzle and safety gate system, will be used for the modification of the Aircraft

Number Three—Third successful launch of the Space Shuttle Columbia from NASA's Kennedy Space Center, Fla., March 22 at 11 a.m. EST.

Landing Dynamics Facility at Langley which enables Langley scientists to perform aircraft and spacecraft landing gear research. The facility uses a water jet system to propel a test carriage equipped with landing gear along a rail/track system under simulated runway conditions. The new propulsion system will be capable of accelerating the test carriage to 220 knots within 400 feet. Under the terms of the firm-fixed-price supply contract, the S & Q Corporation will be responsible for the design, fabrication, assembly, delivery and tests of the propulsion system.

Space Shuttle Launches for 1982

Orbiter	Launch Date	Launch Site	Payload
*Columbia (OV-102)	March 22	KSC	OSS-1
Columbia (OV-102)	July	KSC	DOD 82-1
Columbia (OV-102)	November	KSC	SBS-B, Telesat-E

*Successful launch

Expendable Launches for 1982

Name	Launch Date	Vehicle	Range	Mission Remarks
*RCA-C[1]	January 15	Delta	ESMC	RCA communications. Reimbursable.
*Westar-IV	February 25	Delta	ESMC	Western Union communications. Reimbursable.
*Intelsat V-D	March 4	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Insat 1A	April 8	Delta	ESMC	India communications. Reimbursable.
NOAA-E/SAR	June	Atlas-73E	WSMC	NOAA/SAR weather. Reimbursable.
Navy 21	June	Scout	WSMC	DOD transit. Reimbursable. Callup.
Intelsat V-E	July	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Landsat-D	July	Delta	WSMC	NASA earth resources applications.
Telesat-G (Anik-D1)	August	Delta	ESMC	Canada communications. Reimbursable.
Westar-V	September	Delta	ESMC	Western Union communications. Reimbursable.
RCA-E	October	Delta	ESMC	RCA communications. Reimbursable.
San Marco-D/L	November	Scout	ESMC	International cooperative/Italy.
Intelsat VA-A	December	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.

*Successful launch

Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
James R. Currie and Raymond R. Schansman, NASA/MSFC	Photoelectric detection system	4,319,133	MSFC
Robert E. Frazer, Caltech/JPL	Constant magnification optical tracking system	4,320,290	NRO/JPL
Nick J. Constantinides, Caltech/JPL	Echo tracker/range finder for radars and sonars	4,320,397	NRO/JPL
Kenneth E. Wood, Rockwell International Corp., Downey, Calif.	High temperature penetrator assembly with bayonet plug & ramp-activated lock	4,320,911	JSC
Richard J. Stirn and Yea-Chuan M. Yeh, Caltech/JPL	Method of fabricating Schottky barrier solar cell	4,321,099	NRO/JPL
Robert E. Frazer, Caltech/JPL	Strong thin membrane structure for use as solar sail comprising substrate with reflective coating on one surface and an infrared emissivity increasing coating on the other surface	4,321,299	NRO/JPL
Philip A. Studer and John Paulkovich NASA/GSFC	Non-contacting power transfer device	4,321,572	GSFC

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

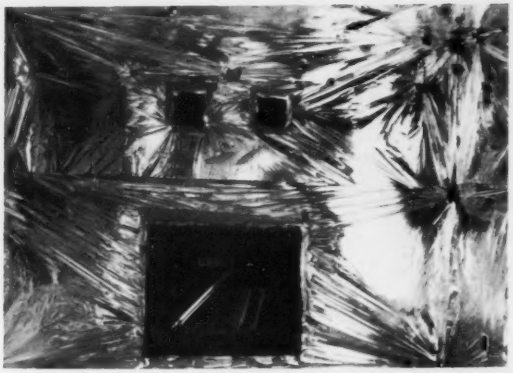
Home Energy Efficiency

A spinoff of NASA technology developed for the Apollo spacecraft has resulted in a home design that is exceptionally energy efficient and known as the Watt Count house.*

Watt Count originated at Arnold Engineering Development Center, Tullahoma, Tenn., whose engineers worked in test and evaluation of Apollo Systems, specifically energy transfer research. On a lunar mission, temperatures outside the Apollo spacecraft ranged from a searing 400 degrees Fahrenheit to a supercold minus 400 degrees. Yet inside Apollo, astronauts worked in an atmosphere approximating homelike conditions, thanks to a highly advanced environmental control system whose total energy expenditure was equivalent to that of ten 150-watt electric light bulbs—the Watt Count System.

The first Watt Count homes, built during the early 1970s, showed impressive results; today more than 600 of these homes have been built.

Watt Count uses computerized energy consumption analysis on plans for a new home. The company calculates heating and cooling loads and customizes the most energy-efficient system for the structure. Optimum insulation is combined with a specifically designed heat pump central heating and air conditioning system.



Watt County officials say their design and analysis techniques are so accurate that they are able to give homeowners a 2-year guarantee that the home's energy consumption will not exceed the kilowatt hour level determined by the computer in their energy consumption analysis.

A distinguishing Watt feature is the use, usually on walls exposed to the outside, of a highly effective aluminized heat shield once employed as a radiation barrier on the Apollo command and lunar modules and on other space systems. This material holds in or keeps out radiant heat, air flow and water vapor. Another key factor is the careful selection of insulating materials, several types of which may be used on a single structure.

*NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA
National Aeronautics and Space Administration

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U.S. GOVERNMENT PRINTING OFFICE 1982-0- 361-563/110